DIW Berlin

German Institute
for Economic Research

Discussion Papers

344

Dieter Schumacher

Home Market and Traditional Effects on Comparative Advantage in a Gravity Approach

Berlin, April 2003

DIW Berlin

German Institute
for Economic Research

Königin-Luise-Str. 5
14195 Berlin,
Germany

Phone +49-30-897 89-0
Fax +49-30-897 89-200

www.diw.de

ISSN 1619-4535

Home Market and Traditional Effects on Comparative Advantage in a Gravity Approach

by

Dieter Schumacher*

DIW Berlin (German Institute for Economic Research)

Abstract

Policy makers in "small" countries facing trade liberalisation have become concerned with the potential loss of manufacturing employment and output to "large" economies in the presence of economies of scale in production and international transport costs. This paper offers a methodology to estimate the "home market" effect for numerous industries, after accounting for transport costs and traditional comparative advantage effects. The empirical results suggest significant home-market effects in many manufacturing industries which may be capital intensive or labour intensive.

Key words: Home-market effect, comparative advantage, bilateral trade, factor endowment, gravity model

JEL classification: F 12

* Dieter Schumacher, DIW Berlin (German Institute for Economic Research), Department of International Economics, Koenigin-Luise-Str. 5, D-14195 Berlin, postal address: D-14191 Berlin, phone: ..49/(0)30/89789-670 or -252; fax: -108, e-mail: dschumacher@diw.de

The author is grateful to Jeffrey H. Bergstrand, Paul Gregory, Arne Melchior, Michael Pflüger and Jürgen Roth for valuable comments on earlier drafts of this paper, and to Gerlinde Hoepp-Hoffmann and Karin Hollmann for carefully carrying out the computations.

I. Introduction

Trade theories identify two main sources of comparative advantage, namely differences in relative and absolute factor endowment. The traditional Heckscher-Ohlin-type models indicate that the commodity patterns of trade between two countries are shaped by relative factor endowment with given technologies and tastes (e.g. Deardorf 1982). The capital-rich country exports capital-intensive goods and imports labour-intensive goods. The new economic geography models, which allow for monopolistic competition, increasing returns to scale and transport costs, suggest that countries having identical relative endowments but differing in size, engage in interindustry trade with the larger country a net exporter in the increasing returns sector (Krugman 1980). This phenomenon is called the home-market effect.

Convincing empirical tests of these theoretical arguments concerning the effects of factor endowment and size are rare, yield contradictory results, and refer to aggregated product groups. Tests of the factor-proportions theory do not consider differences in size. They mainly refer to the Heckscher-Ohlin-Vanek theorem on the factor content of trade and perform poorly in terms of volume and direction of net factor trade patterns (Trefler 1995). More plausible results have been achieved by using alternative assumptions on technology and considering distance between countries (Davis and Weinstein 1998a, Hakura 2001). Empirical evidence on the Heckscher-Ohlin-Vanek theorem's implication that net exports are a linear function of the factor endowment yields an unexpected negative impact of high-skilled labour on net exports of human capital-intensive goods (Leamer 1984 and updated by Song 1994). On the other hand, the empirical tests of the home-market hypothesis have not considered the traditional comparative advantage effects that may be related to differences in per capita income (Feenstra et al. 1998, Melchior 1998). Studies that include total income and per capita income have analysed exports *or* imports (e.g. Bergstrand 1989, Schumacher 1997, Fidrmuc 1998), but not exports *and* imports or their ratios to elaborate on the patterns of comparative advantage.

This paper explains the ratios of exports to imports in bilateral trade using a gravity-type approach at the industry level. It is the first study which shows how the home-market effect surfaces in the gravity equation using a model of monopolistic competition and accounting for traditional comparative advantage effects. To this end we refer to the microeconomic foundations of the gravity equation provided by Bergstrand (1989). Combining geography and factor-proportions theory, Bergstrand derived a gravity-type equation at the industry level which predicts that the exports of a good in bilateral trade depend on income and per capita income of the two countries and the distance between them, assuming a constant elasticity of transformation (CET) of supplies among different markets. We develop the approach further to determine the bilateral patterns of comparative advantage in terms of sectoral export/import ratios as a function of relative income and relative per capita income. Thus, we can distinguish between the home-market effect and traditional comparative advantage effects. The paper also contributes to the present discussion on the sources of trade represented by the gravity equation (Harrigan 2001, Evenett and Keller 2001).

Section II summarises the microeconomic foundations of the "gravity equation" at the level of product groups and the empirical evidence so far available. Section III shows that the gravity-type approach implies a nonlinear relationship between the export/import ratios in bilateral trade, on one hand, and total income and per capita income on the other. It also shows that the home-market effect arises for differentiated products which have a low elasticity of transformation among markets because the costs of marketing and tailoring the products to any foreign market are high. Section IV provides empirical results at the level of three-digit industries of the International Standard Industrial Classification (ISIC). The conclusions in section V suggest that the empirical results are in line with the model. The home-market effect appears in a large number of manufacturing industries which may be capital intensive or labour intensive. Finally, directions for further research are outlined.

II. Theoretical Foundations of the Gravity Equation and Empirical Evidence

The gravity model, first advanced by Tinbergen (1962) and Linnemann (1966), assumes that bilateral trade is positively related to the two countries' incomes and negatively related to the distance between them. It proved successful in explaining empirically regional patterns of aggregated trade. In recent years, the gravity approach has gained new favour in the analysis of regionalisation trends in world trade[1] and in estimating potential trade flows with eastern Europe after the political and economic changes occurred in the region.[2]

[1] E.g. Frankel 1993, Saxonhouse 1993, Dhar and Panagariya 1994.

[2] Several studies consider trade at the aggregate level (e.g. Winters and Wang 1994, Baldwin 1994, Piazolo 1997), while others also provide analyses at the level of product groups (e.g. Festoc 1995, Vittas and Mauro 1997, Schumacher 1997, Fidrmuc 1998).

The gravity equation is derived theoretically as a reduced form from a general equilibrium model of international trade in final goods. Formal analysis was provided by Anderson (1979), Krugman (1980), Bergstrand (1985) and Helpman and Krugman (1985) linking trade flows to exporter and importer incomes multiplicatively in models with differentiated goods. Feenstra et al. (1998) derived a gravity equation from a reciprocal-dumping model of trade with homogeneous goods and Deardorff (1998) showed that the gravity hypothesis is consistent with Heckscher-Ohlin trade in homogeneous goods and perfect competition. Baier and Bergstrand (2001) give an overview of the various theoretical foundations and show that they are complementary and special cases of a more general model.[3] In these models, exporter and importer incomes are interpreted as their production and absorption capacities. Distance between them is taken as a proxy of trade costs.

An important common feature of "economic geography models" with trade costs and monopolistic competition under increasing returns to scale is the "home-market effect".[4] It appears as an elasticity of exports with respect to domestic income which exceeds the importing country's income elasticity. In a two-sector-model with trade costs and monopolistic competition, Krugman (1980) showed that large countries tend to be net exporters in the sector with monopolistic competition. Following these lines, Melchior (1998) demonstrated how home-market effects may influence the trade pattern in a multi-country framework. Disaggregating by five major product groups according to the Standard International Trade Classification (SITC), he found a home-market effect for chemicals as well as machinery and transport equipment, the opposite holds for primary commodities, with resource based and light industry sectors being intermediate cases. Feenstra et al. (1998) arrived at similar results using a different approach, showing that the home-market effect also characterises a homogeneous-product sector with free entry. The effect is reversed if homogeneous goods have greater barriers to entry (e.g. due to resource-dependency). Applying a classification of goods suggested

[3] "Specialization – and not new or old trade theory – generates the force of gravity." (Grossman 1998: 29). The reason for specialisation may be different, however, and may be related to product differentiation by country of origin (Armington-type import demand), economies of scale or factor endowment differences (Feenstra et al. 1998: 1). Evenett and Keller (2001) try empirically to separate between Heckscher-Ohlin theory and the Increasing Returns trade theory as driving forces behind the success of the gravity equation. Their analysis is not disaggregated by industries, but by groups of countries.

[4] Models with increasing returns and trade costs have come to be known as "economic geography", the phenomenon of unusually strong demand leading a good to be exported in a world of economic geography is known as the "home market effect" (Davis and Weinstein 1998b: 1/2). Davis (1998) shows that the relative trade costs for differentiated and homogeneous goods are crucial for the home market effect and that it disappears when the two kinds of goods have identical transport costs.

by Rauch (1999),[5] Feenstra et al. (1998) found a home-market effect for differentiated goods, the reverse is true for homogeneous goods likely to be resource based and to have large entry barriers, and goods with reference prices are lying between the two extremes.

Integrating the gravity hypothesis into the factor-proportions theory of trade, Bergstrand (1989) extended the microeconomic foundations to include exporter and importer per capita incomes. He shows that the gravity equation is the reduced form of a general equilibrium model of bilateral trade among N countries with two differentiated-products industries, with increasing returns to scale and monopolistic competition, and two factors of production. Each firm's output is assumed to be distributed among domestic and foreign markets according to the constant-elasticity-of-transformation (CET) function. “Intuitively, each firm's behavior can be considered as a two-stage process. First, each firm *produces* a uniquely differentiated commodity under increasing returns to scale. In the second stage, each firm *distributes* its product to N markets (including the home market) under diminishing returns, similar to Krugman (1987)” (Bergstrand 1989, 145). The coefficients of the resulting gravity equation are determined by the parameters of the demand and supply functions. They are negative for transport costs and protectionist measures and positive for GNP in the importing country and, if the elasticity of substitution in consumption exceeds one, for GNP in the exporting country. The exporter per capita income coefficient is positive for goods which are capital intensive in production and negative for labour-intensive goods.[6] The importer per capita income coefficient is positive for goods which are ”luxury” in consumption and negative for “necessities”. Thus, the coefficients of per capita GNP can be used to rank the industries (i) by their capital intensity in production and (ii) by their characteristics in import demand. Bergstrand gives no interpretation, however, of the coefficients of the exporter and importer total incomes.

A relatively small number of studies applying the gravity model at the level of product groups are available. Empirical evidence is to be found in Bergstrand (1989) and Fidrmuc (1998) for one-digit SITC groups, in Vittas and Mauro (1997) and Festoc (1997b) for selected two-digit SITC categories. The studies refer to trade among EU member countries or to a larger sample of OECD countries. The results differ, depending on the year and the sample of countries. All in all, the values of the exporter per capita income elasticities suggest that machinery and

[5]He classified the goods as to whether they are (i) traded in an organised exchange, and therefore treated as “homogeneous”, (ii) not traded in an organised exchange, but having some quoted “reference price”, and (iii) not having any quoted prices, and therefore treated as “differentiated”.

[6] This strictly holds for two goods; in the multi-industry case “a weak inference of the relative factor intensity of the industry can be made using exporter per capita income coefficient estimates from a gravity equation” (Bergstrand 1989: 146, referring to Deardorff 1982 who provided a “weak” generalisation of the Heckscher-Ohlin theorem by proving that countries tend to export those goods which use intensively their abundant factor).

transport equipment, chemicals, raw materials and fuels are capital intensive in production whereas miscellaneous manufactured articles, in particular clothing, are labour intensive. The importer per capita income elasticities suggest that miscellaneous manufactured articles, manufactured goods classified chiefly by material and food tend to be luxuries in consumption whereas chemicals, raw materials and fuels tend to be necessities.

This paper shows that in a gravity model with monopolistic competition in the spirit of Bergstrand (1989) there is also a home-market effect arising from differences in total income besides the traditional comparative advantage effect arising from differences in per capita income. Our analysis, therefore, covers both total income and per capita income in order to distinguish between the two sources of comparative advantage. The existing literature on the home-market effect, both theoretical as well as empirical, only considers total income and neglects per capita income. Moreover, the existing literature analyses the impact on the flows of trade whereas we emphasise the impact on the ratio of exports to imports. Our approach is described in the next section.

III. Income, Per Capita Income and Comparative Advantage: The Model

The gravity equation in log-form is given by

$$\ln X_{aij} = \beta_0^a + \beta_1^a \ln Y_i + \beta_2^a \ln y_i + \beta_3^a \ln Y_j + \beta_4^a \ln y_j + \beta_5^a \ln D_{ij} + \sum_{k=6}^{K} \beta_k^a Z_{kij} \qquad (1)$$

X_{aij} is the value of the trade flow in industry a from country i to country j (i,j = 1, ..., N). Y_i is i's national output; following the interpretation in Bergstrand (1989), it is expressed in terms of units of capital.[7] It represents the supply capacity of the exporting country in terms of capital stock and is proxied by GNP. y_i is i's capital-labour endowment ratio which is proxied by i's GNP per capita. Y_j and y_j are j's GNP and GNP per capita, respectively, and represent the demand side. The bilateral trade costs are represented by distance D_{ij} between the economic centers of the respective countries, supplemented by a dummy for adjacency. The other dummy variables Z_{kij} are proxies for trade policy measures and other factors which may be

[7] "Capital" in our context includes tangible and intangible assets. Human capital endowment is highly correlated with GNP per capita and, next to natural resources, it is the decisive factor in determining the sectoral structure of a country's comparative advantage (Wood 1994a and b). This holds particularly for the division of labour between industrial and developing countries, but also for the intersectoral division of labour among industrial countries (e.g. Schumacher 1992).

important for market access such as membership in preference zones, common language or historical ties.

The intersectoral division of labour in bilateral trade can be determined by comparing the exports and imports given by the gravity approach. Equation (1) simultaneously determines exports and imports in bilateral trade. X_{aij} represents the value of exports in industry a from country i to country j. The reverse flow, i.e. the imports of industry a's goods by country i from country j, is given by the same equation replacing i by j and vice versa:

$\ln M_{aij} = \ln X_{aji}$ and

$$\ln X_{aji} = \beta_0^a + \beta_1^a \ln Y_j + \beta_2^a \ln y_j + \beta_3^a \ln Y_i + \beta_4^a \ln y_i + \beta_5^a \ln D_{ji} + \sum_{k=6}^{K} \beta_k^a Z_{kji} \tag{2}$$

Subtracting (2) from (1) gives the log-form of the export/import ratio in bilateral trade of good a. Because $D_{ji} = D_{ij}$ and if $Z_{kji} = Z_{kij}$[8], the log difference between exports and imports is

$$\ln X_{aij} - \ln X_{aji} = \left(\beta_1^a - \beta_3^a\right)\left(\ln Y_i - \ln Y_j\right) + \left(\beta_2^a - \beta_4^a\right)\left(\ln y_i - \ln y_j\right) \tag{3a}$$

or, in non-log form, the export/import ratio is

$$\frac{X_{aij}}{X_{aji}} = \left(\frac{Y_i}{Y_j}\right)^{\beta_1^a - \beta_3^a} \left(\frac{y_i}{y_j}\right)^{\beta_2^a - \beta_4^a} \tag{3b}$$

and depends on the ratio of the two GNPs and the ratio of the two per capita incomes. Distance and dummy variables representing trade preferences among selected countries, in this approach, do not affect the ratio of exports to imports. According to equations (1) and (2), they are relevant for the volume of bilateral trade and affect the commodity structure of trade because the elasticities may vary among industries. As they have the same effect on the exports and imports in a given industry they do not, however, have an impact on the relative sectoral trade volumes.

Relating the export/import ratios in the individual industries to the export/import ratio of all goods combined yields a popular indicator of revealed comparative advantage (RCA) which goes back to Balassa (1965) and is extensively used in empirical analyses.[9] In log-form the RCA values are given by

---

[8] Considering country specific trade barriers we would have a third effect on the export/import ratios arising from trade policy, i.e. a comparative advantage effect of relative levels of protection in terms of tariffs or non-tariff barriers. We only consider "symmetric" trade policy measures such as the existence of Free Trade Areas which, however, may have different effects depending on the product group.

[9] For alternative formulations see Vollrath (1991).

$$\begin{aligned}&\left(\ln X_{aij}-\ln X_{aji}\right)-\left(\ln X_{oij}-\ln X_{oji}\right)\\&\qquad=\left[\left(\beta_1^a-\beta_3^a\right)-\left(\beta_1^o-\beta_3^o\right)\right]\left(\ln Y_i-\ln Y_j\right)\\&\qquad+\left[\left(\beta_2^a-\beta_4^a\right)-\left(\beta_2^o-\beta_4^o\right)\right]\left(\ln y_i-\ln y_j\right)\end{aligned} \tag{4}$$

where the subscript or superscript, respectively, "o" indicates the coefficients for all goods. The indicator is zero at the aggregated level of all products and describes the pattern of comparative advantage between each pair of countries in a standardised way assuming that total bilateral trade is balanced.

The two sources shaping the pattern of comparative advantage can be identified as follows:

(i) If the two countries i and j have the same per capita income, comparative advantage only depends on *relative size*. The export/import ratio in equation (3a) or (3b) and the relative ratio in equation (4) increases with higher β_1^a and lower β_3^a indicating a positive effect on comparative advantage arising from the large size of a country as compared to smaller countries. The difference

$$\beta_1^a-\beta_3^a \tag{5}$$

gives the elasticity of good a's bilateral export/import ratio with respect to the relative total income of the exporting country i at constant per capita income, ie. with respect to total factor endowment. A positive value of (5) indicates a home-market effect which may arise because producers can exploit higher economies of scale in the larger market. In the model, the exporter income elasticity is

$$\beta_1^a=(\sigma^a-1)/(\gamma^a+\sigma^a) \tag{6}$$

and the importer income elasticity is

$$\beta_3^a=(\gamma^a+1)/(\gamma^a+\sigma^a) \tag{7}$$

(Bergstrand 1989: 146). σ^a is the elasticity of substitution in consumption among supplies from different countries according to the import demand functions and may range from 1 to infinity, γ^a is the elasticity of transformation in production among supplies to the home market and different export markets and may range from zero to infinity.[10]

[10] The reason for the assumption that the allocation of output to different markets follows a CET function is that output of a firm in a differentiated-product industry is not likely to be substituted without cost between foreign markets. For details on the CET concept see Baier and Bergstrand (2001:8).

A home-market effect $\beta_1^a > \beta_3^a$ *requires* $\gamma^a < \sigma^a - 2$*, i.e. the elasticity of transformation in production must be small* for any given elasticity of substitution in consumption. The degree of transformability or substitutability of production among markets is small if the costs of distributing, marketing and tailoring a product to any foreign market are high. This will be true the more the goods are specific and tailored to the needs of certain markets, i.e. for more differentiated manufactures. On the other hand, the degree of transformability is infinity if the output is perfectly substitutable across home and foreign markets which is true for more homogeneous goods such as primary commodities. Here, the home-market effect would be reversed. These are the same hypotheses which follow from Krugman (1980), Melchior (1998) and Feenstra et al. (1998) suggesting that the size of the exporting country will be more important than the size of the importing country for differentiated goods in manufacturing whereas the opposite will hold for homogeneous goods such as raw materials or resource-intensive products.[11]

(ii) If the two countries have the same economic size, the pattern of comparative advantage in bilateral trade is only shaped by supply and demand conditions which are *related to per capita income*. The export/import ratio in equation (3a) or (3b) and the relative ratio in equation (4) is larger the larger β_2^a and the smaller β_4^a, i.e. the more the respective good is capital intensive in production and the more it is necessity in consumption, and it is smaller the smaller β_2^a and the larger β_4^a, i.e. the more the respective good is labour intensive in production and the more it is luxury in consumption. The difference of the two coefficients

$$\beta_2^a - \beta_4^a \qquad (8)$$

gives the elasticity of good a's bilateral export/import ratio with respect to the relative per capita income of the exporting country i at constant overall income and describes the *traditional comparative advantage effect*. Ranking the industries by the value of (8) should describe the typical intersectoral division of labour between high-income and low-income countries. The pattern is more pronounced, the larger the divergence of per capita income in country i over per capita income in country j.

These findings are in line with the "stages approach" to comparative advantage (Balassa 1984) which suggests that the factor endowment depends on the level of development meas-

[11] If the elasticity of transformation among markets is smaller than infinity a home-market effect $\beta_1^a > \beta_3^a$ also appears in the gravity model of Baier and Bergstrand (2001). Evenett and Keller (2001) cannot take account of a home-market effect because they assume $\beta_1^a = \beta_3^a = 1$. Both studies analyse trade at the aggregated level.

ured by per capita income. Less developed countries have a smaller capital stock per capita than more developed countries and therefore exchange labour-intensive goods for capital-intensive goods. Alongside with per capita income the capital endowment is growing and therefore, with increasing level of development the export of capital-intensive goods is growing as well. Thus, intra-industry trade increases and the RCA pattern becomes "flatter".

Our findings also explain why a country may have different comparative advantage in bilateral trade depending on the per capita income of the partner country: The trade of developing countries with developed countries is characterised by the export of labour-intensive goods whereas capital-intensive goods play a more important role in trade with other developing countries (Havrylyshyn and Wolf 1981). For the central and eastern European countries in transition too, the RCA pattern in trade with developing countries differs from that in trade with western industrialised countries (Trabold 1996). The approach also suggests that the geographic location of a country plays an important role for its pattern of comparative advantage in total trade. This becomes immediately clear if, for example, one compares countries such as Germany and Japan, which have a similar factor endowment and the same level of per capita income. Because Japan lies close to countries at a lower stage of development, whereas most of Germany's neighbouring countries have a comparable level, Japanese and German commodity patterns of total foreign trade differ considerably.

In sum, the model allows to distinguish between two sources of comparative advantage in bilateral trade. On one hand, $\beta_1^a - \beta_3^a$ gives the comparative advantage effect arising from different size and identifies a home-market effect if it is positive. It is an indicator of the level of product differentiation because it is larger the lower the degree of transformability of production among markets. On the other hand, $\beta_2^a - \beta_4^a$ gives the traditional comparative advantage effect arising from different relative factor endowment net of demand conditions related to per capita income. The values of β_2^a are an indicator of the capital versus labour intensity of industries while the values of β_4^a are an indicator of the degree of luxury versus necessity in consumption. The home-market effect on comparative advantage is strengthened by the traditional comparative advantage effect if goods are capital intensive and/or necessities, it is mitigated if they are labour intensive and/or luxuries.

IV. Empirical Results

We apply equation (1) to explain the bilateral shipments among 22 OECD countries,[12] as well as equations (3a) and (4) to determine the effects of relative total income and relative per capita income on the export/import ratios. The regressions are calculated for the average annual trade flows of the years 1988 to 1990 (in US-$ million) for all products combined, agriculture, mining and quarrying, manufacturing products as a whole and broken down by 25 three-digit ISIC industries.[13] For this purpose the OECD foreign trade figures are appropriately recoded from the original SITC categories.

As to the explanatory variables the data on GNP (in US-$ million) and GNP per capita (in US-$) are taken from World Bank publications and refer to 1989.[14] The distance D_{ij} (in miles) between the countries i and j is calculated as the shortest line between their economic centres EC_i and EC_j by latitudinal and longitudinal position[15]. The dummy variables cover

- adjacency (ADJ_{ij})
- membership in a preference area: European Union (EU_{ij}), European Free Trade Agreement ($EFTA_{ij}$), Free Trade Agreement between the USA and Canada ($CUSTA_{ij}$) and Asia-Pacific Economic Cooperation ($APEC_{ij}$),
- ties by language (LAN_{ij}) and
- historical ties (COL_{ij}).

The value of the dummy variable is 1, if the two countries i and j have a common land border, belong to the respective preference zone, or have the same language[16] or historical ties.[17] Otherwise the value of the variable is zero.

---

[12] Member countries in 1993, excluding Iceland and taking Belgium/Luxembourg together.

[13] Similar regressions and the data are also described in Schumacher (1997) which gives empirical results for all goods, as well as manufacturing products as a whole and broken down by high, medium and low-tech products.

[14] World Development Indicators. GNP figures are calculated by multiplying GNP per capita and population figures. All values are at current prices and exchange rates.

[15] In principle, the national capitals were taken as the economic centre except for Canada (Montreal), the United States (Kansas City as a geographical compromise between the centres of the East and West Coasts), Australia (Sydney), West Germany (Frankfurt/Main), Brazil (Rio de Janeiro), Pakistan (Karachi), and India (Bombay). The formulae are:

$$\cos D_{ij} = \sin \varphi_i \cdot \sin \varphi_j + \cos \varphi_i \cdot \cos \varphi_j \cdot \cos (\lambda_j - \lambda_i)$$

$$D_{ij} = \arccos (\cos D_{ij}) \cdot 3962.07 \text{ miles}$$

for $EC_i = (\varphi_i; \lambda_i)$ and $EC_j = (\varphi_j; \lambda_j)$ with φ = latitude, λ = longitude.

[16] 0.5 for second languages.

[17] 0.5 for ties until 1914.

For estimating the regression coefficients, we apply an OLS procedure on the log-linear form of the gravity equations replacing zero trade flows by a very small figure.[18] Zero values, in general, do not occur in trade among OECD countries at the aggregate level. A number of bilateral trade flows are, however, zero if the figures are disaggregated by product groups. In principle a Tobit estimator taking proper account of zero values would be more appropriate. In similar applications of a gravity equation, however, the Tobit results are very similar to the OLS estimator, where zero values are replaced by a very small figure.[19]

The regressions describing the bilateral trade flows among OECD countries were calculated for export statistics and for import statistics.[20] Both statistics represent the same flows, the values are, however, different, but the results are very similar.[21] The explanatory power of the model is strong as it is common for gravity equations for total trade. The R^2 for all goods and all manufactures is 0.9, in the individual sectors they range from a minimum of 0.5 to 0.6 in mining, agriculture, wood products and petroleum products to a maximum of 0.8 and higher in precision engineering goods, machinery, metal products, plastic products and printing goods. By and large, the results show the expected pattern with regard to sign and significance of the coefficients. The higher the national product of countries and the smaller the geographical distance between them, the greater the merchandise flows between them. Membership of APEC and of the EU in general has a positive impact on exports and imports. The same is true for relationships in terms of language and historical ties. The impact of a common border too, is mostly positive as might be expected; it is, however, less significant than in other studies.

The estimated *income elasticities* as well as the difference between exporter and importer income elasticities giving the impact of relative size on the export/import ratio are presented in Table A.1 in the Appendix. In Figure 1, the difference $\beta_1^a - \beta_3^a$ is represented ranking the sectors from positive to negative values. For all goods combined the difference is zero. The difference is negative in food, paper, non-ferrous metals and mining goods, i.e. primary or resource-intensive goods confirming the results of Feenstra et al. (1998) and Melchior (1998). It is positive for most manufactures indicating a significant home-market effect. As

[18] Adding 0.001 US-$ million. This is the smallest unit recorded in international trade statistics.

[19] See Baldwin (1994: 85) and Wang and Winters (1991: 119).

[20] The complete results of the regressions are given in the Appendix Tables 1 and 2.

[21] Main reasons for different export and import figures are the c.i.f. valuation of imports versus f.o.b. valuation of exports and different recording by time, partner countries or product groups. Despite these divergences the regression results are by and large consistent. The standard errror is somewhat smaller using the import statistics.

distinct from Melchior (1998) we also find a home-market effect for labour-intensive goods. The effect is largest for rubber, transport equipment, pottery and footwear.

Alternative regressions excluding per capita income give a different picture. Here the impact of income on the export/import ratio is negative in agriculture and mining as well as in food, textiles and clothing. It is again zero for all goods combined and positive for most manufacturing products. The values, however, now are highest for the capital-intensive sectors such as transport equipment, electrical and non-electrical machinery and precision engineering whereas the effects in the labour-intensive industries such as clothing, footwear and leather goods tend to be smaller than before or even negative. These findings are in line with Melchior (1998)'s results at a more aggregated level. The income elasticities in an approach excluding per capita income, however, are not necessarily due to total income alone. They may partly reflect the impact of per capita income reinforcing the effect in the capital-intensive industries and diminishing the effect in the labour-intensive industries.

The estimated per capita income elasticities are compiled in Table A.2. The *exporter per capita income elasticities* indicate that food, wood products, furniture, paper, printing, chemicals, plastic products, non-ferrous metals, metal products, machinery, electrical goods, transport equipment, precision engineering goods and other manufactured goods are capital intensive in production ($\beta_2^a > 0$). On the other hand, agricultural products, textiles, wearing apparel, footwear, pottery, glass and structural clay products tend to be labour intensive ($\beta_2^a < 0$). The same result holds for mining products and petroleum products, which does not seem to be reliable. As for the characteristics of demand the *importer per capita income elasticity* indicates that wearing apparel, footwear, wood products, furniture as well as printing, rubber and plastic products, pottery, glass, metal products and other manufactures are luxuries ($\beta_4^a > 0$), whereas industrial chemicals as well as iron and steel tend to be necessities in consumption ($\beta_4^a < 0$). Manufacturing goods as a whole are capital intensive no effect arising from the demand side.

Taking both sides together we can identify the impact of relative per capita income on the export/import ratios in bilateral trade by the difference of the two elasticities $\beta_2^a - \beta_4^a$ which gives the traditional comparative advantage effect. These differences and the deviations from all products are also presented in Table A.2. In Figure 2 the sectors are ranked according to the value of the elasticities' differences. Relative per capita income has a positive impact on the bilateral export/import ratio for all goods and for manufacturing as a whole. This finding is in line with traditional theory suggesting a net capital export from the capital-rich high income country to the capital-poor low income country due to higher capital productivity in the low income country. The comparative advantage of a high income country in trade with a country at a lower level of income tends to be in those product groups for which the difference is larger than for all products combined. On the other hand, higher income countries tend to have comparative disadvantage in the product groups below that level. The largest comparative advantage is in paper products, precision engineering, machinery, chemicals, non ferrous metals, transport equipment and electrical machinery. The strongest disadvantage of a relatively rich country is in wearing apparel, footwear, pottery, textiles, glass and structural clay products.

In industrial chemicals, both production and consumption characteristics contribute to the comparative advantage (capital-intensive necessities), in wearing apparel, footwear, pottery and glass both sides contribute to the comparative disadvantage (labour-intensive luxuries). For wood and plastic products the positive effect of capital intensity on comparative advantage is diminished by demand characteristics, in furniture the net effect is even negative because the demand side outweighs the supply side (capital-intensive luxuries). There is no significant correlation between the ranking of sectors by production and demand characteristics. All in all, the traditional comparative advantage effect in trade among OECD countries is determined more by production characteristics than by demand conditions.[22]

The significant empirical results are summarised in Table 1. It presents the industries which have a home-market effect, ranked according to the size of that effect, and it shows (i) whether their products are capital or labour intensive and (ii) whether the goods are luxuries or necessities. The compilation suggests that the home-market effect surfaces in numerous manufacturing industries which may be capital intensive or labour intensive and which tend to produce luxuries. The conclusions are confirmed by rank correlations including all manufacturing sectors. The rank correlation coefficient between $\beta_1^a - \beta_3^a$ and β_2^a is slightly negative (r = - 0.29 and significant at the 16 % level), i.e. the differentiation of products measured by the size of the home-market effect is not positively correlated with the capital intensity of production as it is often assumed, e.g. in Helpman and Krugman (1985). On the other hand, the

[22] Spearman's rank correlation coefficient r between the ranking of all manufacturing sectors according to β_2^a and β_4^a is - 0.18. The ranking of sectors according to $\beta_2^a - \beta_4^a$ is more similar to β_2^a (r = 0.9 and significant at the 1 % level) than β_4^a (r = - 0.5 and significant at the 1 % level).

home-market effect tends to be larger the more the goods are luxury (r between $\beta_1^a - \beta_3^a$ and β_4^a is 0.38 and significant at the 6 % level). In sum, there is a negative rank correlation between the total income effect $\beta_1^a - \beta_3^a$ and the per capita income effect $\beta_2^a - \beta_4^a$ (r = - 0.40 and significant at the 5 % level). I.e the home-market effect and the traditional comparative advantage effect tend to go into the opposite direction.

Table 1

Characteristics of industries which have a home-market effect (import statistics)

Home-market effect	Factor intensity	Luxury versus necessity
384 Transport equipment	capital intensive	.
355 Rubber products	.	luxury
324 Footwear	labour intensive	luxury
361 Pottery, china earthware	labour intensive	luxury
362 Glass and glass products	labour intensive	luxury
342 Printing and publishing	capital intensive	luxury
383 Electrical machinery	capital intensive	.
382 Machinery	capital intensive	.
322 Wearing apparel	labour intensive	luxury
352 Other chemical products	capital intensive	.
356 Plastic products	capital intensive	luxury
369 Structural clay products	labour intensive	.
381 Fabricated metal products	capital intensive	luxury
390 Other manufacturing	capital intensive	luxury
321 Textiles	labour intensive	.
385 Measuring, photogr., optical etc.	capital intensive	.

V. Conclusions

We showed that the home-market effect also surfaces in a model of monopolistic competition with differentiated products under increasing returns to scale which accounts for traditional comparative advantage effects and transport costs. The model in the spirit of Bergstrand (1989) assumes a constant elasticity of transformation of supplies among domestic and foreign markets and suggests that large countries have comparative advantage in differentiated manufactures which are not likely to be substituted without considerable costs between individual markets. This is the same conclusion which follows from more restricted models such as Krugman (1980), Melchior (1998) and Feenstra et al. (1998) which do not account for traditional comparative advantage effects. Estimating the home-market effect without accounting for the comparative advantage effect arising from relative factor endowment may distort the results in the sense that they partly reflect the factor intensity of the product.

Our approach implies an explanation of the sectoral export/import ratios in bilateral trade as a nonlinear function of income and per capita income of the two countries concerned. *Total income* represents the market size which has a positive effect on comparative advantage in most manufacturing industries whereas it has no or even a negative effect in raw materials and in resource-intensive goods. This finding largely confirms the results of other studies on the home-market effect. As distinct from these studies which do not consider per capita income separately we also find a home-market effect for labour-intensive industries. The effect of *per capita income* represents the degree of capital intensity versus labour intensity of the goods in production and the degree of luxury versus necessity in consumption, respectively. Here, our empirical results are weaker for raw materials and several raw material intensive goods, whereas the model performs well and gives consistent results for manufacturing products for which the endowment with (human) capital versus labour is the most important factor of competitiveness.

In sum, the empirical evidence shows that the home-market effect appears in a large number of manufacturing industries which may be capital intensive or labour intensive. This means that the comparative advantage of low income countries arising from relative factor endowment, in several labour-intensive industries can be partly offset by the larger economic size of high income countries. On the other hand, the traditional comparative advantage of high income countries, in several capital-intensive industries can be strengthened by their economic size. The ranking of industries according to their degree of differentiation as measured by the home-market effect does not correspond to their capital versus labour intensity. This is in line with Bergstrand (1990: 1223) assuming that product differentiation is not linked to factor intensity and confirms the empirical examination of Evenett and Keller (2001: 10) who did not find a correlation between the capital intensity of products and various proxies of the degree of differentiation. On the other hand, our results give limited support to the assumption that differentiated goods are luxuries (Bergstrand 1990:1223). Factor intensity and demand characteristics in terms of luxury versus necessity are not correlated.

Further research may improve our gravity-type approach at the level of industries in various respects. The model should be extended to cover additional factors of production, e.g. natural resources, as well as human and physical capital separately. Further disaggregation may give more homogeneous product groups, and trade of non-OECD countries should be integrated into the empirical analysis. As a result the number of zero values can be expected to grow, increasing the necessity to apply an estimation procedure for limited dependent variables. Finally, it may be asked whether the vertical differentiation by price and quality segments within product groups follows a similar pattern of explanation as the intersectoral division of labour analysed here. Theoretical arguments and empirical evidence suggest that high income countries tend to specialise in the high price and quality segments whereas low income countries tend to supply high shares of the low price and low quality segment.

References

Anderson, J. E., 1979. A Theoretical Foundation for the Gravity Equation, American Economic Review LXIX, 106-116.

Baier, S. L., Bergstrand, J. H., 2001. The growth of world trade: tariffs, transport costs, and income similarity, Journal of International Economics 53, 1-27.

Balassa, B., 1984. A 'Stages Approach' to Comparative Advantage, Asian Journal of Economics and Social Studies 3 (3), 1-35.

Balassa, B., 1965. Trade Liberalization and 'Revealed' Comparative Advantage, The Manchester School of Economic and Social Studies 33, 99-123.

Baldwin, R. E., 1994. Towards an Integrated Europe. Centre for Economic Policy Research, London.

Bergstrand, J. H., 1990. The Heckscher-Ohlin-Samuelson Model, the Linder Hypothesis and the Determinants of Bilateral Intra-Industry Trade, The Economic Journal 100, 1216-1229.

Bergstrand, J. H., 1989. The Generalized Gravity Equation, Monopolistic Competition, and the Factor Proportions Theory in International Trade, Review of Economics and Statistics LXXI, 143-153.

Bergstrand, J. H., 1985. The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence, Review of Economics and Statistics LXVII, 474-481.

Davis, D. R., 1998. The Home Market, Trade, and Industrial Structure, The American Economic Review, 1264-1276.

Davis, D. R., Weinstein, D. E., 1998a. An Account of Global Factor Trade. Draft 1.1, September 28. Harvard University/University of Michigan Business School.

Davis, D. R., Weinstein, D.E., 1998b. Market Access, Economic Geography and Comparative Advantage: An Empirical Assessment. NBER Working Paper 6787. Cambridge, MA.

Deardorff, A., 1982. The General Validity of the Heckscher-Ohlin Theorem, American Economic Review LXXII, 683-694.

Dhar, S., Panagariya, A., 1994. Is East Asia Less Open than North America and the European Economic Community? No. The World Bank Policy Research Working Paper 1370. Washington, DC.

Evenett, S. J., Keller, W. 2001. On Theories Explaining the Success of the Gravity Equation. Journal of Political Economy, forthcoming.

Feenstra, R. C., Markusen, J. A., Rose, A. K., 1998. Understanding the Home Market Effect and the Gravity Equation: The Role of Differentiating Goods. NBER Working Paper 6804. Cambridge, MA.

Festoc, F., 1995. The trade potential in sensitive sectors between the European Union and the Central European Countries: preliminary results. Mimeo. Université de Nantes.

Fidrmuc, J., 1998. Effects of Integration of the CEEC into the EU on Austrian Trade Structure, in: Pichelmann, K. (Ed.), The Economic Consequences of Eastern Enlargement of the European Union. The Austrian View. Research Report. Institute for Advanced Studies, Vienna.

Frankel, J. A., 1993. Is Japan Creating a Yen Bloc in East Asia and the Pacific?, in: Frankel, B. (Ed.), Regionalism and Rivalry: Japan and the United States in Pacific Asia. University of Chicago Press, Chicago.

Grossman, G. M., 1998. Comment. In Frankel, B. (Ed.), Regionalism and Rivalry: Japan and the United States in Pacific Asia. University of Chicago Press, Chicago.

Hakura, D. S., 2001. Why does HOV fail? The role of technological differences within the EC. Journal of International Economics 54, 361-382.

Harrigan, J., 2001. Specialization and the Volume of Trade: Do the Data Obey the Laws? NBER Working Paper 8675. Cambridge, MA. Forthcoming 2002 in Choi, K., Harrigan, J. (Eds.), The Handbook of International Trade. Basil Blackwell, London.

Havrylyshyn, O., Wolf, M., 1981. Trade among Developing Countries: Theory, Policy Issues and Principle Trends. World Bank Staff Working Paper No. 479. Washington.

Helpman, E., Krugman, P., 1985. Market Structure and Foreign Trade. MIT Press, Cambridge, MA.

Krugman, P., 1987. Pricing to Market when the Exchange Rate Changes, in: Arndt, S. W., Richardson, J. D. (Eds.), Real-Financial Linkages Among Open Economies. MIT Press, Cambridge, MA.

Krugman, P., 1980. Scale economies, product differentiation and the pattern of trade. American Economic Review 70, 950-959.

Leamer, E. E., 1984. Sources of International Comparative Advantage: theory and evidence. MIT Press, Cambridge, MA.

Linnemann, H., 1966. An Econometric Study of International Trade Flows. North-Holland Publishing Co, Amsterdam.

Melchior, A., 1998. Market Size Effects as an Explanation of the Gravity Relationship in International Trade. Paper to the Conference on International Trade and Market Structures, 2-3 April 1998 in Paris/Le Mans. Preliminary Draft. Norwegian Institute of International Affairs.

Piazolo, D., 1997. Trade Integration between Eastern and Western Europe: Policies Follow the Market. Journal of Economic Integration 12, 259-297.

Rauch, J. R., 1999. Networks versus Markets in International Trade. Journal of International Economics 48, 7-35.

Saxonhouse, G. R., 1993. Trading blocs and East Asia, in De Melo, J., Panagariya, A. (Eds.), New Dimensions in Regional Integration. Cambridge University Press, Cambridge.

Schumacher, D., 1997. Impact on German trade of increased division of labor with Eastern Europe, in Black, S. W. (Ed.), Europe's economy looks east. Implications for Germany and the European Union. Cambridge University Press, Cambridge.

Schumacher, D., 1992. A Note on the Human Capital Intensity of EC trade. Cahiers Economiques de Bruxelles 133, 3-19.

Song, Lijang, 1994. Changing sources of international comparative advantage: a Byesian estimation of the trade dependence model. Economics Division Working Papers 94/8. The Australian National University, Research School of Pacific and Asian Studies. Canberra.

Trabold, H., 1996. Central and Eastern Europe’s Trade with OECD Countries: New Tigers Ante Portas? Konjunkturpolitik 42, 85-112.

Trefler, D., 1995. The Case of the Missing Trade and Other Mysteries. American Economic Review 85, 1029-1046.

Vittas, H., Mauro, P., 1997. Potential trade with core and periphery: industry differences in trade patterns, in Black, S. W. (Ed.), Europe's economy looks east. Implications for Germany and the European Union. Cambridge University Press, Cambridge.

Vollrath, T. V., 1991. A Theoretical Evaluation of Alternative Trade Intensity Measures of Revealed Comparative Advantage. Weltwirtschaftliches Archiv (Review of World Economics) 127, 265-280.

Wang, Z. K., Winters, L. A., 1991. The Trading Potential of Eastern Europe. CEPR Discussion Paper Series No. 610. London.

Winters, L. A., Wang, Z. K. 1994. Eastern Europe's international trade. Manchester University Press, Manchester/New York.

Wood, A., 1994a. North-South Trade, Employment and Inequality. Changing Fortunes in a Skill-Driven World. Clarendon Press, Oxford.

Wood, A., 1994b. Give Heckscher and Ohlin a Chance. Weltwirtschaftliches Archiv (Review of World Economics) 130, 20-49.

Appendix: Bergstrand's gravity model for two industries

The representative consumer l in country j is assumed to maximise a "nested" Cobb-Douglas-CES-Stone-Geary utility function:

$$U_{jl} = \left[\left(\sum_{n=1}^{N} \sum_{h=1}^{H_{An}} x_{Ahnjl}^{\theta^A} \right)^{1/\theta^A} \right]^{\delta} \left[\left(\sum_{n=1}^{N} \sum_{h=1}^{H_{Bn}} x_{Bhnjl}^{\theta^B} \right)^{1/\theta^B} - \bar{x}_B \right]^{1-\delta} \tag{1}$$

subject to the consumer's nominal income

$$Y_{jl} = \sum_{a=A,B} \sum_{n=1}^{N} \sum_{n=1}^{H_{an}} \left(p_{anj} \; T_{anj} \; / \; E_{nj} \right) x_{ahnjl} \tag{2}$$

x_{Ahnjl} is the amount of the (manufactured) output of industry A's firm h in country n demanded by consumer-worker l in country j and x_{Bhnjl} , analogously, refers to the (non-manufactured) output of industry B. $\bar{x}_B$ is the minimum consumption requirement of good B (common to a Stone-Geary utility function). p_{anj} is the f.o.b. price in country n's currency of firm h's output of industry a (a = A, B) exported from country n to country j; for simplicity it is assumed that all firms in country n in an industry charge the same price in market j. T_{anj} is one plus the exogenous tariff rate on industry a's exports from n to j (tariff factor), and E_{nj} is the exogenous exchange rate defined as n's currency per unit of j's currency. The three price components combined give the c.i.f. price in j's currency.

Maximising (1) subject to (2) gives a set of Armington-like bilateral import demand functions. Aggregating demand curves over consumers which are assumed to be identical in j gives a country j's demand curve for good A produced by firm g in country i: Demand decreases with increasing price and increases with income and income per capita. $\sigma^A = 1/(1-\theta^A)$ is the elasticity of substitution in consumption $\left(0 < \sigma^A < \infty\right)$. y_j is the per capita income, "capita" being expressed in terms of the minimum consumption requirement of good B, i.e.

$y_j = Y_j / \left(p_{Bj} \, \bar{x}_B\right) L_j$ where p_{Bj} is the weighted average price of B from all sources and L_j is the number of consumer-workers in country j. Analogously, demand curves for industry B's output exist replacing (1-1/y_j) by (1+ [δ (1- δ)] 1/y_j). These functions imply that the national income elasticity of demand for A (B) will be greater (less) than one if per capita income rises.

The representative firm h in each of the two industries in country i is assumed to maximise profits producing a uniquely differentiated product in a market that can be characterised as Chamberlinian monopolistic competition, using two factors of production, labour (L) and capital (K). All firms and countries have identical technology which takes the linear form:

$$L_{agi} = \alpha_{La} + \beta_{La}\, x_{agi} \tag{3}$$

$$K_{agi} = \alpha_{Ka} + \beta_{Ka}\, x_{agi} \tag{4}$$

L_{agi} and K_{agi} are the labour and capital, respectively, required by firm g in industry a in country i to produce the output x_{agi}. The α's are fixed set up costs, the β's are the constant input requirements per unit of output. Labour and capital are available in fixed supply L_i and K_i, respectively, in each country i. The wage rate for labour and the rental rate for capital are determined in competitive markets.

Transport costs are considered by means of a constant-elasticity-of-transformation (CET) function of distribution of output among domestic and foreign markets, where C_{ain} is the c.i.f./f.o.b. factor (> 1) to ship output of industry a from country i to country n:[23]

$$x_{agi} = \left[\sum_{n=1}^{N} \left(C_{ain} x_{agin} \right)^{\phi^a} \right]^{1/\phi^a} \tag{5}$$

where $1 < \phi^a < \infty$. "Intuitively, each firm's behavior can be considered as a two-stage process. First, each firm *produces* a uniquely differentiated commodity under increasing returns to scale. In the second stage, each firm *distributes* its product to N markets (including the home market) under diminishing returns, similar to Krugman (1987)" (Bergstrand 1989, 145).

Maximising profits yields equations for the marginal costs of exporting to any markets. They give the shipments from country i to country j as a positive function of price p_{aij} and a negative function of transport costs C_{aij}. $\gamma^a = 1/(\phi^a - 1)$ is the elasticity of transformation in production among supplies to the home market and different export markets ($0 < \gamma^a < \infty$).

[23] Only a portion of a shipment arrives at its destination; the part lost in transit represents the resources required to ship the output, as in Krugman (1980).

In equilibrium, supply is equal to demand on each market. As a result the value of bilateral shipments is given by a function taking the form of a "generalized" gravity quation:

$$px_{aij} = e^{\beta_0^a} Y_i^{\beta_1^a} y_i^{\beta_2^a} Y_j^{\beta_3^a} y_j^{\beta_4^a} C_{aij}^{\beta_5^a} T_{aij}^{\beta_6^a} E_{ij}^{\beta_7^a} \pi_i^{\beta_8^a} \pi_j^{\beta_9^a} \qquad (6)$$

Here, px_{aij} is the value of the trade flow in industry a from country i to country j at f.o.b. price. Y_i is i's national output expressed in terms of units of capital and, in the typical estimations, is proxied by GNP and represents the supply capacity of the exporting country. y_i is i's capital-labour endowment ratio which is proxied by i's GNP per capita. Y_j and y_j are j's GNP and GNP per capita, respectively. The c.i.f./f.o.b. ratios C_{aij} are proxied by distance between the economic centers of the respective countries in the typical gravity equation, supplemented by a dummy for adjacency. Trade policy measures T_{aij} are in general represented by dummies for the membership in preference zones. The remaining three terms are variables referring to the exchange rate, an overall impact of the price level of exporting country i with regard to all export markets and of the price level in importing country j vis-à-vis all supplier countries.

References

Bergstrand, J. H., 1989. The Generalized Gravity Equation, Monopolistic Competition, and the Factor Proportions Theory in International Trade, Review of Economics and Statistics LXXI, 143-153.

Krugman, P., 1987. Pricing to Market when the Exchange Rate Changes, in: Arndt, S. W., Richardson, J. D. (Eds.), Real-Financial Linkages Among Open Economies. MIT Press, Cambridge, MA.

Krugman, P., 1980. Scale economies, product differentiation and the pattern of trade. American Economic Review 70, 950-959.

Table A.1

Income elasticities by industries for trade among 22 OECD countries 1988-90

Product groups (ISIC Rev.2)		Export statistics: Shipments: Income of the exporting country i β^a_1	Export statistics: Shipments: Income of the importing country j β^a_3	Export statistics: Export/import ratio $\beta^a_1 - \beta^a_3$	Export statistics: RCA value 1)	Import statistics: Shipments: Income of the exporting country i β^a_1	Import statistics: Shipments: Income of the importing country j β^a_3	Import statistics: Export/import ratio $\beta^a_1 - \beta^a_3$	Import statistics: RCA value 1)
0	All products	0,75 **	0,78 **	-0,03	0,00	0,74 **	0,75 **	-0,01	0,00
1	Agriculture	0,79 **	0,86 **	-0,07	-0,04	0,72 **	0,77 **	-0,05	-0,04
2	Mining and quarrying	1,01 **	1,08 **	-0,06	-0,03	0,86 **	1,01 **	-0,16 *	-0,15 *
3	Manufacturing	0,76 **	0,78 **	-0,02	0,01	0,76 **	0,74 **	0,02	0,03
31	Food, beverages, tobacco	0,37 **	0,85 **	-0,48 **	-0,45 **	0,36 **	0,82 **	-0,46 **	-0,45 **
321	Textiles	0,74 **	0,68 **	0,06	0,09 *	0,73 **	0,60 **	0,13 **	0,13 **
322	Wearing apparel	0,98 **	0,81 **	0,17 **	0,20 **	0,99 **	0,69 **	0,30 **	0,31 **
323	Leather and leather products	0,92 **	0,99 **	-0,07	-0,04	0,89 **	0,90 **	-0,01	0,00
324	Footwear	1,09 **	0,69 **	0,39 **	0,42 **	1,13 **	0,64 **	0,48 **	0,49 **
331	Wood and wood products	0,55 **	0,68 **	-0,13	-0,10	0,57 **	0,66 **	-0,09	-0,08
332	Furniture	0,87 **	0,90 **	-0,03	0,00	0,88 **	0,80 **	0,08	0,09
341	Paper and paper products	0,63 **	0,80 **	-0,17	-0,13	0,63 **	0,80 **	-0,18 *	-0,17 **
342	Printing and publishing	1,10 **	0,76 **	0,34 **	0,37 **	1,09 **	0,69 **	0,40 **	0,41 **
351	Industrial chemicals	1,01 **	0,90 **	0,11 *	0,14 **	0,91 **	0,90 **	0,01	0,02
352	Other chemical products	0,93 **	0,78 **	0,15 **	0,18 **	0,97 **	0,72 **	0,25 **	0,26 **
353/4	Petroleum refineries and prod.	1,31 **	1,20 **	0,12	0,15	1,39 **	1,25 **	0,14	0,15
355	Rubber products	1,27 **	0,69 **	0,58 **	0,61 **	1,24 **	0,67 **	0,57 **	0,58 **
356	Plastic products	0,76 **	0,63 **	0,12 **	0,15 **	0,79 **	0,58 **	0,21 **	0,22 **
361	Pottery, china and earthware	1,37 **	0,90 **	0,47 **	0,50 **	1,31 **	0,86 **	0,45 **	0,46 **
362	Glass and glass products	1,21 **	0,91 **	0,30 **	0,33 **	1,22 **	0,81 **	0,42 **	0,43 **
369	Structural clay products	1,10 **	0,85 **	0,26 **	0,29 **	1,05 **	0,88 **	0,17 **	0,18 **
371	Iron and steel basic industr.	1,11 **	1,02 **	0,08	0,11	1,06 **	0,96 **	0,10	0,11
372	Basic non ferrous metals	0,91 **	1,07 **	-0,16 *	-0,12 *	0,82 **	0,99 **	-0,17 **	-0,16 **
381	Fabricated metal products	0,86 **	0,76 **	0,11 **	0,14 **	0,86 **	0,70 **	0,16 **	0,17 **
382	Machinery (excl. electrical)	0,96 **	0,75 **	0,22 **	0,25 **	1,00 **	0,70 **	0,30 **	0,31 **
383	Electrical machinery	1,02 **	0,70 **	0,32 **	0,35 **	1,04 **	0,67 **	0,36 **	0,37 **
384	Transport equipment	1,47 **	0,91 **	0,56 **	0,59 **	1,43 **	0,80 **	0,63 **	0,64 **
385	Measuring, photogr.,optical etc.	0,86 **	0,81 **	0,05	0,08	0,89 **	0,78 **	0,11 **	0,12 **
390	Other manufacturing industries	1,04 **	0,86 **	0,18 **	0,22 **	0,96 **	0,80 **	0,16 **	0,17 **

Note: ** indicates significance at 99 % level, * indicates significance at 95 % level.

1) $\beta^a_1 - \beta^a_3$ of industry a minus $\beta^0_1 - \beta^0$ for all products.

Source: Own calculations, for method see text.

Table A.2

Per-capita-income elasticities by industries for trade among 22 OECD countries 1988-90

		Export statistics				Import statistics			
		Shipments				Shipments			
	Product groups	Per capita income of the exporting country i	Per capita income of the importing country j	Export/ import ratio	RCA value	Per capita income of the exporting country i	Per capita income of the importing country j	Export/ import ratio	RCA value
	(ISIC Rev.2)	β_2^a	β_4^a	$\beta_2^a - \beta_4^a$	1)	β_2^a	β_4^a	$\beta_2^a - \beta_4^a$	1)
0	All products	0,29 **	-0,02	0,31 **	0,00	0,27 **	0,02	0,26 **	0,00
1	Agriculture	-0,74 **	-0,08	-0,66 **	-0,98 **	-0,71 **	-0,02	-0,69 **	-0,94 **
2	Mining and quarrying	-0,71 **	0,01	-0,73 **	-1,04 **	-0,53 **	-0,32	-0,21	-0,47 **
3	Manufacturing	0,34 **	-0,01	0,35 **	0,03	0,32 **	0,03	0,30 **	0,04
31	Food, beverages, tobacco	0,18	0,13	0,05	-0,26 **	0,24 **	0,07	0,17 *	-0,09
321	Textiles	-0,60 **	0,03	-0,63 **	-0,95 **	-0,62 **	0,16	-0,78 **	-1,03 **
322	Wearing apparel	-1,36 **	0,69 **	-2,06 **	-2,37 **	-1,38 **	1,21 **	-2,59 **	-2,85 **
323	Leather and leather products	-0,19	-0,22	0,03	-0,29 **	-0,12	-0,10	-0,02	-0,28 **
324	Footwear	-0,53 **	0,83 **	-1,37 **	-1,68 **	-0,63 **	0,89 **	-1,52 **	-1,78 **
331	Wood and wood products	1,02 **	0,36 *	0,66 **	0,34 *	1,09 **	0,39 **	0,69 **	0,44 **
332	Furniture	0,86 **	0,64 **	0,22	-0,09	0,68 **	0,98 **	-0,30 *	-0,56 **
341	Paper and paper products	1,85 **	-0,11	1,96 **	1,65 **	1,82 **	-0,20	2,02 **	1,76 **
342	Printing and publishing	0,99 **	0,47 **	0,52 **	0,20	0,77 **	0,67 **	0,10	-0,16 *
351	Industrial chemicals	0,33 **	-0,16	0,49 **	0,18	0,56 **	-0,31 **	0,86 **	0,61 **
352	Other chemical products	1,01 **	-0,03	1,04 **	0,72 **	0,90 **	0,00	0,90 **	0,64 **
353/4	Petroleum refineries and prod.	-0,56 **	-0,11	-0,45 **	-0,77 **	-0,57 **	-0,20	-0,37 *	-0,63 **
355	Rubber products	-0,17	0,26 *	-0,43 **	-0,74 **	-0,12	0,23 *	-0,35 **	-0,61 **
356	Plastic products	1,06 **	0,37 **	0,69 **	0,38 **	0,89 **	0,47 **	0,42 **	0,16
361	Pottery, china and earthware	-0,72 **	0,33 *	-1,06 **	-1,37 **	-0,65 **	0,35 **	-1,01 **	-1,27 **
362	Glass and glass products	-0,51 **	0,21	-0,72 **	-1,04 **	-0,52 **	0,26 *	-0,78 **	-1,04 **
369	Structural clay products	-0,57 **	0,00	-0,58 **	-0,89 **	-0,51 **	-0,04	-0,47 **	-0,72 **
371	Iron and steel basic industr.	0,12	-0,34 *	0,46 **	0,15	0,13	-0,29 *	0,42 **	0,16
372	Basic non ferrous metals	0,61 **	-0,09	0,70 **	0,38 **	0,79 **	-0,02	0,81 **	0,55 **
381	Fabricated metal products	0,47 **	0,06	0,41 **	0,10	0,44 **	0,20 *	0,24 **	-0,02
382	Machinery (excl. electrical)	1,17 **	-0,07	1,24 **	0,92 **	1,11 **	-0,03	1,14 **	0,88 **
383	Electrical machinery	0,78 **	0,07	0,72 **	0,40 **	0,69 **	0,07	0,63 **	0,37 **
384	Transport equipment	0,88 **	-0,06	0,94 **	0,62 **	0,72 **	0,04	0,68 **	0,42 **
385	Measuring, photogr.,optical etc.	1,95 **	0,15	1,80 **	1,49 **	1,70 **	0,04	1,65 **	1,40 **
390	Other manufacturing industries	0,65 **	0,42 **	0,24 *	-0,08	0,70 **	0,60 **	0,10	-0,16 **

Note: ** indicates significance at 99 % level, * indicates significance at 95 % level.

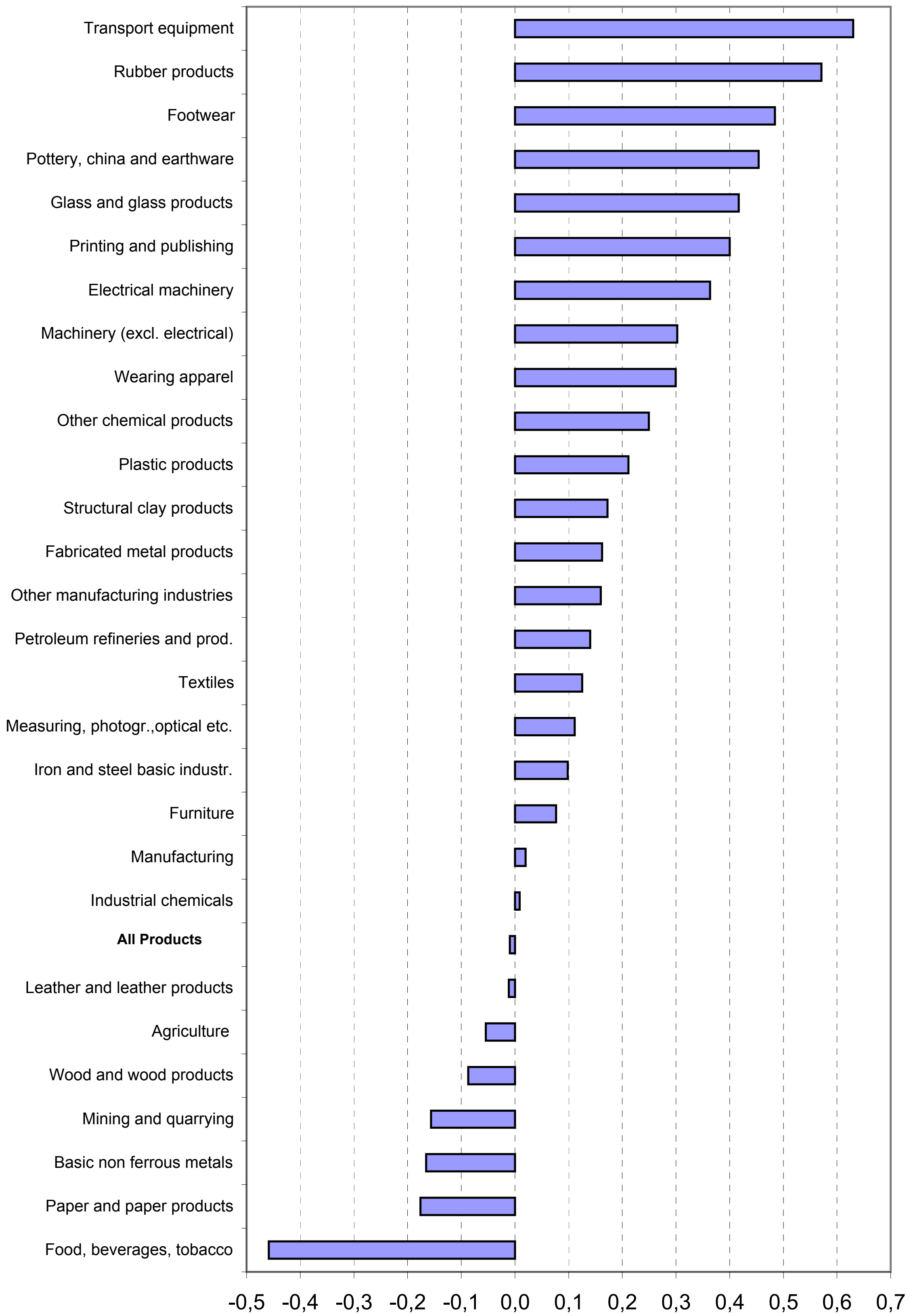
1) $\beta_2^a - \beta_4^a$ of industry a minus $\beta_2^0 - \beta^0$ for all products.

Source: Own calculations, for method see text.

Figure 1

Comparative advantage effect of relative size $(\beta_1^a - \beta_3^a)$

- Import statistics for trade among 22 OECD countries 1988-90 -

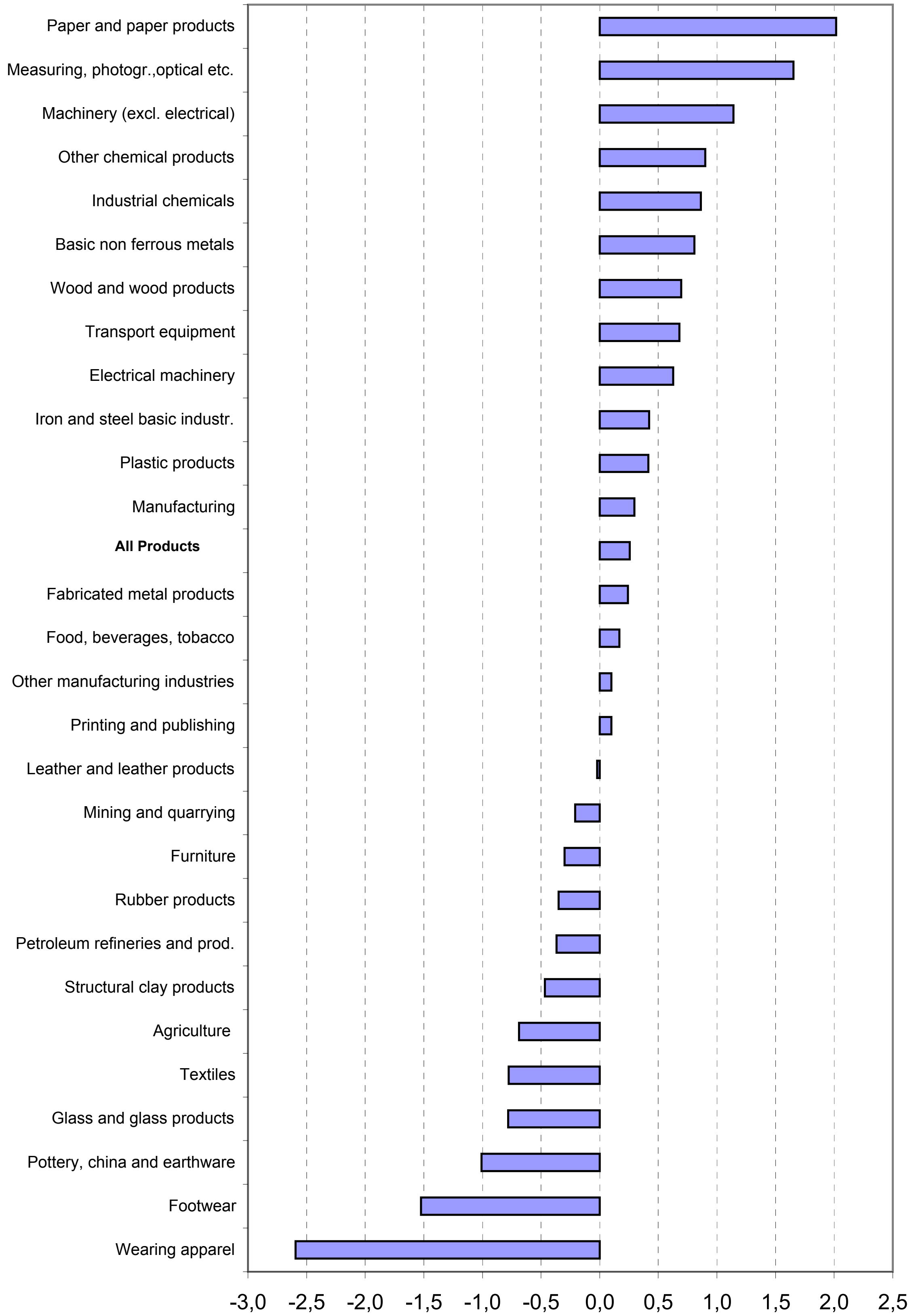


Source: Table A.1.

Figure 2

Comparative advantage effect of relative per capita income $(\beta_2^a - \beta_4^a)$

- Import statistics for trade among 22 OECD countries 1988-90 -



Source: Table A.2.

Appendix:

Detailed Regression Results

Table 1

Regression results for trade among 22 OECD countries by product groups: export statistics, 1988-90

Product groups	Y_i	y_i	Y_j	y_j	D_{ij}	ADJ_{ij}	EU_{ij}	$EFTA_{ij}$	$CUSTA_{ij}$	$APEC_{ij}$	LAN_{ij}	Col_{ij}	constant	standard error	adjusted R^2
All products	0,75 **	0,29 **	0,78 **	-0,02	-0,76 **	0,26 *	0,43 **	-0,16	-0,03	0,76 **	0,51 **	0,93 **	-9,36	0,62	0,89
	(29,8)	(5,8)	(31,2)	(-0,4)	(-23,3)	(2,1)	(5,2)	(-1,0)	(-0,1)	(4,6)	(4,2)	(2,6)			
1 Agriculture	0,79 **	-0,74 **	0,86 **	-0,08	-0,67 **	0,65 *	1,20 **	-0,50	-0,64	0,92 *	1,32 **	-0,80	-5,43	1,65	0,57
	(11,8)	(-5,6)	(12,9)	(-0,6)	(-7,7)	(2,0)	(5,4)	(-1,2)	(-0,5)	(2,1)	(4,1)	(-0,8)			
2 Mining and quarrying	1,01 **	-0,71 **	1,08 **	0,01	-1,46 **	-0,12	-0,14	-0,82	0,55	0,88	1,37 **	1,66	-7,12	2,40	0,51
	(10,5)	(-3,7)	(11,2)	(0,1)	(-11,6)	(-0,3)	(-0,4)	(-1,3)	(0,3)	(1,4)	(2,9)	(1,2)			
3 Manufacturing	0,76 **	0,34 **	0,78 **	-0,01	-0,83 **	0,19	0,46 **	-0,12	0,00	0,71 **	0,51 **	1,00 *	-9,75	0,70	0,88
	(27,1)	(6,0)	(27,8)	(-0,2)	(-22,6)	(1,4)	(4,9)	(-0,7)	(0,0)	(3,8)	(3,7)	(2,5)			
31 Food, beverages, tobacco	0,37 **	0,18	0,85 **	0,13	-0,48 **	0,55 *	1,81 **	-0,27	-0,64	1,00 **	1,14 **	0,78	-11,54	1,18	0,70
	(7,8)	(1,9)	(18,0)	(1,4)	(-7,7)	(2,3)	(11,5)	(-0,9)	(-0,7)	(3,2)	(4,9)	(1,1)			
321 Textiles	0,74 **	-0,60 **	0,68 **	0,03	-0,89 **	0,39	0,91 **	-0,06	-1,14	0,78 *	0,81 **	1,05	-2,65	1,25	0,67
	(14,6)	(-6,0)	(13,4)	(0,3)	(-13,4)	(1,6)	(5,4)	(-0,2)	(-1,2)	(2,3)	(3,3)	(1,4)			
322 Wearing apparel	0,98 **	-1,36 **	0,81 **	0,69 **	-1,64 **	-0,29	0,39 *	0,44	-1,19	0,47	0,70 *	1,40	-2,21	1,38	0,78
	(17,6)	(-12,2)	(14,6)	(6,2)	(-22,5)	(-1,0)	(2,1)	(1,3)	(-1,1)	(1,3)	(2,6)	(1,8)			
323 Leather and leather products	0,92 **	-0,19	0,99 **	-0,22	-1,04 **	0,15	0,62 **	0,22	-1,10	0,54	0,62 *	1,93 *	-11,88	1,48	0,67
	(15,5)	(-1,6)	(16,7)	(-1,8)	(-13,3)	(0,5)	(3,1)	(0,6)	(-1,0)	(1,4)	(2,1)	(2,3)			
324 Footwear	1,09 **	-0,53 **	0,69 **	0,83 **	-1,32 **	0,03	1,43 **	0,84	-0,42	-0,18	1,03 **	1,82	-15,81	1,98	0,63
	(13,6)	(-3,3)	(8,8)	(5,2)	(-12,7)	(0,1)	(5,4)	(1,7)	(-0,3)	(-0,3)	(2,7)	(1,6)			
331 Wood and wood products	0,55 **	1,02 **	0,68 **	0,36 *	-1,34 **	0,28	0,31	0,04	0,75	1,17 *	1,07 **	1,54	-17,69	2,04	0,57
	(6,7)	(6,2)	(8,3)	(2,2)	(-12,4)	(0,7)	(1,1)	(0,1)	(0,5)	(2,1)	(2,7)	(1,3)			
332 Furniture	0,87 **	0,86 **	0,90 **	0,64 **	-1,39 **	0,50	0,60 **	0,14	-0,11	0,46	0,75 *	2,28	-25,86	1,62	0,75
	(13,3)	(6,6)	(13,8)	(5,0)	(-16,3)	(1,6)	(2,8)	(0,3)	(-0,1)	(1,1)	(2,4)	(2,4)			
341 Paper and paper products	0,63 **	1,85 **	0,80 **	-0,11	-1,35 **	0,06	0,22	-0,12	0,59	1,39 **	0,02	2,76 *	-22,23	1,89	0,66
	(8,3)	(12,2)	(10,5)	(-0,7)	(-13,6)	(0,2)	(0,9)	(-0,2)	(0,4)	(2,7)	(0,0)	(2,5)			
342 Printing and publishing	1,10 **	0,99 **	0,76 **	0,47 **	-1,14 **	0,00 *	0,99 **	-0,30	-0,38	0,26	1,97 **	2,45 **	-28,35	1,32	0,82
	(20,7)	(9,3)	(14,4)	(4,4)	(-16,5)	(-0,0)	(5,6)	(-0,9)	(-0,4)	(0,7)	(7,6)	(3,2)			
351 Industrial chemicals	1,01 **	0,33 **	0,90 **	-0,16	-1,24 **	-0,11	0,45 *	-0,25	-0,37	0,64	0,61 *	1,61	-12,74	1,30	0,76
	(19,2)	(3,2)	(17,2)	(-1,5)	(-18,1)	(-0,4)	(2,6)	(-0,8)	(-0,4)	(1,8)	(2,4)	(2,1)			
352 Other chemical products	0,93 **	1,01 **	0,78 **	-0,03	-1,03 **	-0,16	0,86 **	-0,33	-0,66	-0,05	1,16 **	1,68 *	-20,46	1,40	0,74
	(16,4)	(8,9)	(13,9)	(-0,3)	(-13,9)	(-0,6)	(4,6)	(-0,9)	(-0,6)	(-0,1)	(4,2)	(2,1)			
353/4 Petroleum refineries and prod.	1,31 **	-0,56 **	1,20 **	-0,11	-1,76 **	-0,01	1,07 **	-0,08	-0,26	1,02	1,14 *	2,26	-11,62	2,45	0,62
	(13,3)	(-2,8)	(12,2)	(-0,5)	(-13,7)	(-0,0)	(3,3)	(-0,1)	(-0,1)	(1,6)	(2,4)	(1,6)			
355 Rubber products	1,27 **	-0,17	0,69 **	0,26 *	-1,27 **	-0,11	0,67 **	0,41	0,32	0,60	0,61 *	1,32	-14,72	1,39	0,76
	(22,6)	(-1,5)	(12,4)	(2,3)	(-17,4)	(-0,4)	(3,6)	(1,1)	(0,3)	(1,6)	(2,2)	(1,6)			
356 Plastic products	0,76 **	1,06 **	0,63 **	0,37 **	-1,15 **	0,28	0,96 **	-0,21	-0,12	0,57	1,07 **	1,37 *	-21,63	1,15	0,82
	(16,4)	(11,5)	(13,8)	(4,1)	(-19,1)	(1,2)	(6,3)	(-0,7)	(-0,1)	(1,8)	(4,8)	(2,1)			

Table 1 continued

Regression results for trade among 22 OECD countries by product groups: export statistics, 1988-90

Product groups	Y_i	y_i	Y_j	y_j	D_{ij}	ADJ_{ij}	EU_{ij}	$EFTA_{ij}$	$CUSTA_{ij}$	$APEC_{ij}$	LAN_{ij}	Col_{ij}	constant	standard error	adjusted R^2
361 Pottery, china	1,37 **	-0,72 **	0,90 **	0,33 *	-1,06 **	0,30	0,80 **	0,75	-1,47	-0,05	0,83 *	2,93 **	-17,46	1,73	0,68
and earthenware	(19,6)	(-5,2)	(12,9)	(2,4)	(-11,6)	(0,9)	(3,5)	(1,7)	(-1,1)	(-0,1)	(2,4)	(2,9)			
362 Glass and glass	1,21 **	-0,51 **	0,91 **	0,21	-1,30 **	0,14	0,37	0,25	-0,89	0,80 *	1,01 **	1,46	-13,31	1,71	0,68
products	(17,5)	(-3,7)	(13,2)	(1,6)	(-14,5)	(0,4)	(1,6)	(0,6)	(-0,7)	(1,7)	(3,0)	(1,5)			
369 Structural clay	1,10 **	-0,57 **	0,85 **	0,00	-1,31 **	0,29	0,53 *	0,36	0,06	0,39	0,44	1,94 *	-8,17	1,55	0,70
products	(17,6)	(-4,6)	(13,6)	(0,0)	(-16,1)	(0,9)	(2,6)	(0,9)	(0,0)	(0,9)	(1,4)	(2,2)			
371 Iron and steel	1,11 **	0,12	1,02 **	-0,34 *	-1,85 **	-0,24	-0,20	0,70	-1,61	2,07 **	0,01	2,97 **	-8,31	1,91	0,68
basic industries	(14,3)	(0,8)	(13,4)	(-2,2)	(-18,4)	(-0,6)	(-0,8)	(1,4)	(-1,1)	(4,0)	(0,0)	(2,7)			
372 Basic non	0,91 **	0,61 **	1,07 **	-0,09	-1,55 **	-0,21	-0,10	0,49	-0,79	1,87 **	0,35	1,78	-16,06	1,68	0,71
ferrous metals	(13,5)	(4,5)	(15,8)	(-0,7)	(-17,4)	(-0,6)	(-0,5)	(1,1)	(-0,6)	(4,2)	(1,1)	(1,8)			
381 Fabricated metal	0,86 **	0,47 **	0,76 **	0,06	-1,20 **	0,16	0,42 **	0,27	-0,28	0,59 *	0,88 **	1,33 *	-13,89	1,09	0,81
products	(19,6)	(5,4)	(17,2)	(0,7)	(-20,8)	(0,8)	(2,8)	(1,0)	(-0,3)	(2,0)	(4,1)	(2,1)			
382 Machinery	0,96 **	1,17 **	0,75 **	-0,07	-0,99 **	-0,21	0,43 **	-0,07	0,21	-0,04	0,86 **	1,09	-20,25	1,13	0,81
(excl. electrical)	(21,1)	(12,8)	(16,4)	(-0,8)	(-16,5)	(-0,9)	(2,8)	(-0,2)	(0,2)	(-0,1)	(3,9)	(1,7)			
383 Electrical	1,02 **	0,78 **	0,70 **	0,07	-1,06 **	-0,30	0,48 **	0,19	0,52	0,04	0,78 **	1,09	-18,08	1,23	0,77
machinery	(20,5)	(7,9)	(14,1)	(0,7)	(-16,3)	(-1,2)	(2,9)	(0,6)	(0,5)	(0,1)	(3,2)	(1,5)			
384 Transport	1,47 **	0,88 **	0,91 **	-0,06	-1,24 **	-0,16 *	0,53 **	0,06	0,49	0,80 *	0,43	1,54	-24,68	1,47	0,80
equipment	(24,8)	(7,4)	(15,4)	(-0,5)	(-16,1)	(-0,5)	(2,7)	(0,2)	(0,4)	(2,0)	(1,5)	(1,8)			
385 Measuring, pho-	0,86 **	1,95 **	0,81 **	0,15	-0,73 **	0,03	0,70 **	-0,29	-0,31	0,00	0,78 **	1,41 *	-33,12	1,19	0,83
togr.,optical etc.	(18,0)	(20,4)	(17,0)	(1,6)	(-11,7)	(0,1)	(4,4)	(-0,9)	(-0,3)	(0,0)	(3,4)	(2,1)			
390 Other manufac-	1,04 **	0,65 **	0,86 **	0,42 **	-0,92 **	0,26	0,50 **	-0,03	-1,22	0,26	0,59 *	1,17	-25,39	1,29	0,77
turing industries	(20,0)	(6,3)	(16,5)	(4,0)	(-13,5)	(1,0)	(2,9)	(-0,1)	(-1,2)	(0,8)	(2,3)	(1,6)			

Note: ** indicates significance at 99 % level, * indicates significance at 95 % level. 449 degrees of freedom.

Source: Own calculations, for method see text.

Table 2

Regression results for trade among 22 OECD countries by product groups: import statistics, 1988-90

	Product groups	Y_i	y_i	Y_j	y_j	D_{ij}	ADJ_{ij}	EU_{ij}	$EFTA_{ij}$	$CUSTA_{ij}$	$APEC_{ij}$	LAN_{ij}	Col_{ij}	constant	standard error	adjusted R^2
	All products	0,74 **	0,27 **	0,75 **	0,02	-0,68 **	0,30 **	0,43 **	-0,18	0,01	0,73 **	0,51 **	0,66 *	-9,47	0,56	0,91
		(32,9)	(6,1)	(33,2)	(0,4)	(-23,3)	(2,7)	(5,8)	(-1,2)	(0,0)	(4,9)	(4,6)	(2,0)			
1	Agriculture	0,72 **	-0,71 **	0,77 **	-0,02	-0,58 **	0,82 *	1,12 **	-0,63	-0,24	1,44 **	0,47	2,08 *	-4,97	1,60	0,55
		(11,3)	(-5,5)	(12,1)	(-0,2)	(-6,9)	(2,6)	(5,3)	(-1,5)	(-0,2)	(3,4)	(1,5)	(2,3)			
2	Mining and quarrying	0,86 **	-0,53 **	1,01 **	-0,32	-1,25 **	-0,21	-0,25	-0,36	0,44	0,51	1,41 **	2,27	-3,50	2,10	0,50
		(10,2)	(-3,2)	(12,0)	(-1,9)	(-11,3)	(-0,5)	(-0,9)	(-0,7)	(0,3)	(0,9)	(3,4)	(1,9)			
3	Manufacturing	0,76 **	0,32 **	0,74 **	0,03	-0,74 **	0,21	0,47 **	-0,14	0,01	0,72 **	0,57 **	0,55	-9,96	0,62	0,89
		(30,4)	(6,4)	(29,4)	(0,5)	(-22,7)	(1,7)	(5,7)	(-0,9)	(0,0)	(4,3)	(4,6)	(1,5)			
31	Food, beverages, tobacco	0,36 **	0,24 **	0,82 **	0,07	-0,39 **	0,59 **	1,79 **	-0,23	-0,55	1,04 **	1,06 **	0,88	-11,60	1,05	0,73
		(8,6)	(2,9)	(19,4)	(0,9)	(-7,1)	(2,8)	(12,7)	(-0,9)	(-0,7)	(3,7)	(5,2)	(1,5)			
321	Textiles	0,73 **	-0,62 **	0,60 **	0,16	-0,79 **	0,46 *	0,90 **	-0,16	-0,98	0,78 *	0,75 **	0,56	-3,32	1,15	0,68
		(15,7)	(-6,7)	(12,9)	(1,7)	(-13,0)	(2,0)	(5,8)	(-0,5)	(-1,1)	(2,5)	(3,3)	(0,8)			
322	Wearing apparel	0,99 **	-1,38 **	0,69 **	1,21 **	-1,48 **	-0,41	0,69 **	0,27	-0,82	0,44	0,78 **	-0,17	-6,85	1,44	0,77
		(17,3)	(-12,0)	(12,0)	(10,5)	(-19,6)	(-1,4)	(3,6)	(0,7)	(-0,7)	(1,1)	(2,8)	(-0,2)			
323	Leather and leather products	0,89 **	-0,12	0,90 **	-0,10	-0,81 **	0,30	0,72 **	0,08	-0,92	0,32	0,62 *	0,10	-13,61	1,39	0,66
		(15,8)	(-1,1)	(16,0)	(-0,9)	(-11,1)	(1,1)	(3,9)	(0,2)	(-0,9)	(0,9)	(2,3)	(0,1)			
324	Footwear	1,13 **	-0,63 **	0,64 **	0,89 **	-1,14 **	-0,01	1,54 **	0,47	-0,32	-0,32	1,25 **	-0,83	-16,65	1,96	0,62
		(14,4)	(-4,0)	(8,2)	(5,7)	(-11,0)	(-0,0)	(5,9)	(0,9)	(-0,2)	(-0,6)	(3,3)	(-0,7)			
331	Wood and wood products	0,57 **	1,09 **	0,66 **	0,39 **	-1,23 **	0,30	0,27	0,05	0,67	1,23 *	1,04 **	1,76	-19,26	1,93	0,59
		(7,3)	(7,0)	(8,4)	(2,5)	(-12,1)	(0,8)	(1,0)	(0,1)	(0,5)	(2,4)	(2,7)	(1,6)			
332	Furniture	0,88 **	0,68 **	0,80 **	0,98 **	-1,33 **	0,51	0,61 **	0,05	-0,02	0,57 **	0,77 **	0,27	-26,65	1,50	0,77
		(14,6)	(5,6)	(13,3)	(8,1)	(-16,8)	(1,7)	(3,1)	(0,1)	(-0,0)	(1,4)	(2,6)	(0,3)			
341	Paper and paper products	0,63 **	1,82 **	0,80 **	-0,20	-1,33 **	0,00	0,16	-0,10	0,48	1,29 **	0,31	0,83	-21,11	1,80	0,67
		(8,7)	(12,6)	(11,1)	(-1,4)	(-14,0)	(-0,0)	(0,7)	(-0,2)	(0,3)	(2,7)	(0,9)	(0,8)			
342	Printing and publishing	1,09 **	0,77 **	0,69 **	0,67 **	-1,03 **	-0,02	0,94 **	-0,36	-0,39	-0,02	2,33 **	-0,08	-27,98	1,28	0,81
		(21,3)	(7,5)	(13,5)	(6,6)	(-15,3)	(-0,1)	(5,5)	(-1,1)	(-0,4)	(-0,1)	(9,3)	(-0,1)			
351	Industrial chemicals	0,91 **	0,56 **	0,90 **	-0,31 **	-1,10 **	-0,10	0,43 **	-0,27	-0,65	0,50 **	1,06 **	-0,53 *	-13,10	1,10	0,80
		(20,6)	(6,3)	(20,3)	(-3,4)	(-19,0)	(-0,5)	(2,9)	(-0,9)	(-0,8)	(1,7)	(4,9)	(-0,8)			
352	Other chemical products	0,97 **	0,90 **	0,72 **	0,00	-0,94 **	-0,16	0,79 **	-0,34	-0,61	-0,30	1,39 **	-0,43	-19,79	1,33	0,74
		(18,1)	(8,4)	(13,4)	(-0,0)	(-13,5)	(-0,6)	(4,4)	(-1,0)	(-0,6)	(-0,8)	(5,3)	(-0,6)			
353/4	Petroleum refin-eries and prod.	1,39 **	-0,57 **	1,25 **	-0,20	-1,63 **	-0,18	0,90 **	-0,26	-0,51	0,62	1,49 **	-0,96	-12,87	2,37	0,62
		(14,6)	(-3,0)	(13,0)	(-1,0)	(-13,0)	(-0,4)	(2,8)	(-0,4)	(-0,3)	(1,0)	(3,2)	(-0,7)			
355	Rubber products	1,24 **	-0,12	0,67 **	0,23 *	-1,14 **	-0,09	0,64 **	0,45	0,51	0,59	0,42	0,77	-15,19	1,26	0,77
		(24,6)	(-1,1)	(13,2)	(2,3)	(-17,1)	(-0,4)	(3,8)	(1,4)	(0,5)	(1,7)	(1,7)	(1,1)			
356	Plastic products	0,79 **	0,89 **	0,58 **	0,47 **	-1,07 **	0,18	0,96 **	-0,29	0,14	0,32	1,33 **	0,11	-21,05	1,11	0,81
		(17,6)	(9,9)	(12,9)	(5,3)	(-18,2)	(0,8)	(6,5)	(-1,0)	(0,2)	(1,1)	(6,1)	(0,2)			

Table 2 continued

Regression results for trade among 22 OECD countries by product groups: import statistics, 1988-90

Product groups	Y_i	y_i	Y_j	y_j	D_{ij}	ADJ_{ij}	EU_{ij}	$EFTA_{ij}$	$CUSTA_{ij}$	$APEC_{ij}$	LAN_{ij}	Col_{ij}	constant	standard error	adjusted R^2
361 Pottery, china	1,31 **	-0,65 **	0,86 **	0,35 **	-0,90 **	0,35	0,87 **	0,67	-1,20	-0,68	1,32 **	-0,30	-18,18	1,62	0,68
and earthenware	(20,2)	(-5,0)	(13,2)	(2,7)	(-10,5)	(1,1)	(4,0)	(1,6)	(-1,0)	(-1,6)	(4,1)	(-0,3)			
362 Glass and glass	1,22 **	-0,52 **	0,81 **	0,26 *	-1,18 **	0,20	0,35	0,13	-0,71	0,54	1,19 **	0,09	-13,26	1,59	0,69
products	(19,1)	(-4,1)	(12,6)	(2,0)	(-14,1)	(0,6)	(1,7)	(0,3)	(-0,6)	(1,3)	(3,8)	(0,1)			
369 Structural clay	1,05 **	-0,51 **	0,88 **	-0,04	-1,25 **	0,28	0,46 *	0,45	0,06	0,17	0,56	-0,77	-8,41	1,49	0,70
products	(17,5)	(-4,2)	(14,6)	(-0,3)	(-15,8)	(0,9)	(2,3)	(1,2)	(0,1)	(0,4)	(1,9)	(-0,9)			
371 Iron and steel	1,06 **	0,13	0,96 **	-0,29 *	-1,71 **	-0,13	-0,12	0,63	-1,41	1,91 **	0,00	0,18	-8,52	1,74	0,69
basic industries	(15,2)	(0,9)	(13,8)	(-2,1)	(-18,7)	(-0,4)	(-0,5)	(1,4)	(-1,1)	(4,1)	(-0,0)	(0,2)			
372 Basic non	0,82 **	0,79 **	0,99 **	-0,02	-1,27 **	0,15	-0,02	0,34	-0,75	1,99 **	0,09	1,65	-18,14	1,52	0,72
ferrous metals	(13,4)	(6,4)	(16,1)	(-0,2)	(-15,8)	(0,5)	(-0,1)	(0,9)	(-0,6)	(4,9)	(0,3)	(1,9)			
381 Fabricated metal	0,86 **	0,44 **	0,70 **	0,20 *	-1,10 **	0,22	0,42 **	0,18	-0,21	0,54 *	0,96 **	0,17	-14,71	1,03	0,81
products	(20,7)	(5,3)	(16,7)	(2,4)	(-20,2)	(1,1)	(3,1)	(0,7)	(-0,3)	(2,0)	(4,7)	(0,3)			
382 Machinery	1,00 **	1,11 **	0,70 **	-0,03	-0,88 **	-0,27	0,51 **	-0,05	0,22	-0,13	1,09 **	0,06	-20,87	1,02	0,84
(excl. electrical)	(24,6)	(13,6)	(17,2)	(-0,3)	(-16,5)	(-1,3)	(3,8)	(-0,2)	(0,3)	(-0,5)	(5,5)	(0,1)			
383 Electrical	1,04 **	0,69 **	0,67 **	0,07	-0,98 **	-0,31	0,50 **	0,17	0,59	-0,06	0,93 **	0,21	-17,62	1,14	0,79
machinery	(22,6)	(7,5)	(14,6)	(0,7)	(-16,3)	(-1,4)	(3,2)	(0,6)	(0,7)	(-0,2)	(4,1)	(0,3)			
384 Transport	1,43 **	0,72 **	0,80 **	0,04	-1,08 **	-0,01	0,64 **	-0,02	0,63	0,79 *	0,56	1,28	-23,60	1,47	0,78
equipment	(24,3)	(6,1)	(13,6)	(0,3)	(-14,0)	(-0,0)	(3,2)	(-0,0)	(0,6)	(2,0)	(1,9)	(1,5)			
385 Measuring, pho-	0,89 **	1,70 **	0,78 **	0,04	-0,64 **	0,02	0,72 **	-0,21	-0,32	-0,14	1,06 **	0,12	-30,14	1,11	0,83
togr.,optical etc.	(19,9)	(19,0)	(17,3)	(0,5)	(-11,0)	(0,1)	(4,9)	(-0,7)	(-0,4)	(-0,5)	(4,9)	(0,2)			
390 Other manufac-	0,96 **	0,70 **	0,80 **	0,60 **	-0,80 **	0,05	0,63 **	-0,23	-0,83	0,10	0,74 **	-0,27	-26,54	1,22	0,78
turing industries	(19,7)	(7,2)	(16,3)	(6,1)	(-12,5)	(0,2)	(3,9)	(-0,7)	(-0,9)	(0,3)	(3,1)	(-0,4)			

Note: ** indicates significance at 99 % level, * indicates significance at 95 % level. 449 degrees of freedom.

Source: Own calculations, for method see text.